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Shoulder-and Back-Muscle Activation During Shoulder Abduction and Flexion Using a Bodyblade Pro Versus Dumbbells

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Comments
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Shoulder and Back Muscle Activation During Shoulder Abduction and Flexion using a Bodyblade Pro versus Dumbbells

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Context: The Bodyblade Pro is utilized for shoulder rehabilitation following injury. Resistance is provided by blade oscillations – faster oscillations or higher speeds correspond to greater resistance. However, research supporting its use is scarce, particularly in comparison to dumbbell training.

Objective: To compare muscle activity, using electromyography (EMG), in the back and shoulder regions during shoulder exercises with the Bodyblade Pro versus dumbbells.

Design: Randomized Crossover Study.

Setting: San Diego State University Biomechanics Lab.

Participants: Eleven healthy male subjects aged 19 to 32.

Intervention(s): Subjects performed shoulder flexion and abduction exercises using a Bodyblade Pro and dumbbells (5, 8, and 10 pounds) while EMG recorded activity of the deltoid, pectoralis major, infraspinatus, serratus anterior, and erector spinae.

Main Outcome Measure(s): Average peak muscle activity (% maximum voluntary isometric contraction) was separately measured for shoulder abduction and flexion in the range of 85° to 95°. Differences among exercise devices were separately analyzed for the flexed and abducted positions using one-way repeated measures ANOVA.

Results: The Bodyblade Pro produced greater muscle activity than all the dumbbell trials. Differences were significant for all muscles measured (all ps < 0.01) except for the erector spinae during shoulder flexion with a 10-pound dumbbell. EMG activity for the Bodyblade Pro exceeded 50% of the MVIC during both shoulder flexion and abduction. For the dumbbell conditions, only the 10-pound trials approached this effect.

Conclusions: Using a Bodyblade during shoulder exercises results in greater shoulder and back muscle recruitment than dumbbells. The Bodyblade Pro can activate multiple muscles in a

single exercise, and thereby minimize the need of multiple dumbbell exercises. The Bodyblade Pro is an effective device for shoulder and back muscle activation that warrants further use by clinicians interested in its use for rehabilitation.

Keywords: bodyblade, electromyography, shoulder rehabilitation

INTRODUCTION

Shoulder injuries commonly occur in athletics, particularly in sports that involve overhead arm motions (i.e., baseball, softball, swimming, and tennis). As such, shoulder-strengthening programs are critical in restoring normal function following upper extremity injuries.[1] Shoulder strengthening programs are effective not only in restoring function, but also in reducing pain,[2] preventing injury, and improving athletic performance.[3]

Clinicians utilize several devices – dumbbells, elastic bands, medicine balls, and machine weights – to increase strength in the shoulder musculature.[4] Dumbbell training is one of the more commonly used techniques to increase shoulder strength, and has been shown to significantly improve rotator cuff strength[5,6] and athletic performance.[3] Townsend et al.[7] evaluated 17 dumbbell exercises for the shoulder region using EMG and concluded that a minimum of four exercises was needed for an effective shoulder rehabilitation program.

The Bodyblade Pro (Hymanson Inc., Playa Del Ray, CA) is an alternative shoulder-strengthening device that was introduced in 1991. The Bodyblade Pro is a 1.5 m (5 ft) 1.1 kg (2.5

lbs) oscillatory device used by physical therapists, athletic trainers and fitness professionals to strengthen the shoulder and core musculature.[8]

Research supports the use of the Bodyblade. Rose et al.[9] found that a strength-training program using the Bodyblade Pro maintained shoulder strength in baseball players during the competitive season. The Bodyblade Pro has also been shown to produce significantly more muscle activation in the scapular stabilizers than either cuff weights or the Thera-band.[10] Additionally, the Bodyblade Pro appears to activate the trunk muscles[11] and may have the potential to enhance upper extremity proprioception.[12]

Although the literature supports the use of the Bodyblade, studies comparing the effectiveness of this device to traditional dumbbells are lacking. As both the Bodyblade and dumbbells are typically used for a similar clinical purpose (i.e., strengthening the shoulder musculature), it is imperative to understand the differences in muscle effort between these two devices. To date, it appears that a complete shoulder rehabilitation program using dumbbells requires at least four exercises.[7] However, the Bodyblade Pro may be able to activate multiple muscles in a single exercise, and thereby minimize the need of multiple dumbbell exercises.

Therefore, the purpose of this study was to examine the differences in muscle activation between the Bodyblade Pro and dumbbell during two commonly used shoulder exercises. Specifically, this study compared muscle activity in the shoulder and back between a 1.1 kg (2.5 lb) Bodyblade Pro and dumbbells of various resistances [2.3 kg (5 lb), 3.6 kg (8 lb) and 4.5 kg (10 lb)]. This study was conducted under the null hypothesis that there would be no differences in muscle activation between the different conditions.

METHODS

Design

Participants performed shoulder exercises using dumbbells and a Bodyblade Pro in a randomized crossover study. The dependent variable was mean EMG activity (%MVIC) for the following muscles: deltoid, pectoralis major, infraspinatus, serratus anterior, and erector spinae. This study had two independent variables: (1) condition [Bodyblade Pro (BPPro); Bodyblade Pro static (control); 5 lb dumbbell (Db5); 8 lb dumbbell (Db8); and 10 lb dumbbell (Db10)] and (2) position (shoulder flexion and shoulder abduction).

Participants

Eleven healthy males participated in this study (age = 24.4 ± 4.5 years, height = 175 ± 9.0 cm, and weight = 78.6 ± 9.7 kg). A health history form was administered to each subject for screening purposes. Participants were excluded if they reported any of the following: (1) history of shoulder instability, (2) limitation in shoulder or elbow motion, (3) an existing shoulder injury (i.e., tendonitis, bursitis, sprain, strain, dislocation, or subluxation), or (4) receiving surgery or physical therapy on the dominant upper extremity in the past year. The researchers administered no exclusions based on sports participation, exercise level, or familiarity with the Bodyblade Pro.

All participants read and signed a consent form before testing. This study was approved by the Institutional Review Board at San Diego State University.

Apparatus

Data were collected using a Noraxon Telemyo electromyography system (Noraxon, Scottsdale, AZ). Myoresearch XP version 1.06 (Noraxon, Scottsdale, AZ) software processed the data. All EMG signals passed through an 8-channel frequency-modulation transmitter. Electrically acquired data were pre-amplified with a gain of 500, bandpass filtered between 10 and 500 Hz, sampled at 1500 Hz, and converted from analog to digital using a 12-bit resolution. Myoelectric activity was detected using five surface electrodes (bipolar silver-silver-chloride) and one reference electrode (monopolar silver-silver-chloride). The electrodes had a surface area of 20 mm and an interelectrode distance of 25 mm. A Logitech Quickcam Pro 5000 (Logitech, Fremont, CA), time synched with the EMG data, was used to capture video footage at 60 Hz. Bodyblade Pro trials were performed using a Bodyblade Pro with a mass of 1.1 kg (2.5 lbs) (Hymanson Inc., Playa Del Ray, CA, United States). Dumbbell trials were performed using 5 lb (2.3 kg), 8 lb (3.6 kg) and 10 lb (4.5 kg) generic weights.

Procedures

Each participant attended two sessions: the first for instruction, and the second for data collection. All sessions were conducted in the Biomechanics Laboratory at San Diego State University and occurred on the same day for each participant. During the first session the researcher (a certified athletic trainer) verbally instructed and demonstrated the proper use of the Bodyblade Pro. Instructions were per the manufacturer's recommendation and directions. Participants then practiced with the Bodyblade until they were able to consistently oscillate the apparatus in the required shoulder positions, as instructed. All subjects demonstrated proficiency with using the Bodyblade Pro.

The second session was for data collection. Prior to electrode placement, the skin was shaved and cleansed with alcohol. Surfaces electrodes were placed on the following muscle bellies of the dominant limb: pectoralis major, infraspinatus, middle deltoid, serratus anterior, and erector spinae. Electrode placement was determined based on the recommendations by Cram and Kasman.[13] Pectoralis major electrodes were placed in the clavicular location, 2 cm below the clavical at an inferior angle in the anterior chest wall. Infraspinatus electrodes were placed in the infraspinous fossa, parallel and approximately 4 cm below the spine of the scapula. The posterior deltoid was palpated during shoulder extension to assure that the electrodes were not located over this muscle. Middle deltoid electrodes were placed on the lateral upper arm approximately 3 cm distal to the acromion, vertically in line with the fibers of the middle deltoid. Serratus anterior electrodes were placed inferior to the axilla, horizontal and level with the inferior angle of the scapula, while the subject maintained the shoulder in flexion. This position allowed simultaneous palpation of the latissumus dorsi; electrodes were placed medial to this muscle. Finally, erector spinae electrodes were placed at the level of L3, parallel to the spine and 2 cm lateral from the spinous process. Correct placement was verified by examining the EMG for each muscle while under tension as described by Cram and Klasman.[13] The arm used to throw a baseball was deemed the dominant limb. The reference electrode was placed over the ipsilateral acromion process.

After electrode placement, a maximal voluntary isometric contraction (MVIC) was obtained for each of the 5 muscles to use for amplitude normalization. Each MVIC was performed by having the participant resist the researcher's manual resistance for five seconds, as specified by Kendall for specific manual muscle testing.[14] The pectoralis major was tested by applying a horizontal abducted force to the distal forearm; the subject was supine with the elbow extended, the shoulder slightly medially rotated in 90° of flexion, and the humerus slightly horizontally adducted. While supine, the serratus anterior was tested by applying a force to the subject's fist into scapular adduction; the subject was supine in 90° of shoulder flexion with the elbow extended and the scapula abducted (i.e., protracted). The subject was then positioned prone, and the infraspinatus was tested by applying an internal rotation torque to the shoulder; the subject was in shoulder external rotation with 90° of shoulder abduction and 90° of elbow flexion. While prone, the erector spinae was resisted as the main researcher applied a force against the back while the subject extended the spine with the hands clasped behind the head and the legs fixed to the floor by a second investigator. Finally, with the subject in a seated position, the middle deltoid was tested by applying a force into shoulder adduction as the subject maintained 90° of should abduction and 90° of elbow flexion. All muscle testing was performed by the same researcher, who had been formally trained in the Kendall technique and had used it clinically for approximately four years. Each MVIC test was performed three times for each muscle, and the average peak value was used for normalizing. Each participant was given one minute of rest between each MVIC.

For the dumbbell trials, participants performed seven repetitions of shoulder flexion and seven repetitions of shoulder abduction with each weight (5, 8, and 10 lbs). All movements were performed standing with the feet shoulder width apart, the elbow at 0° of extension, and the forearm pronated. Subjects were instructed to raise the dumbbell to approximately 110° for both shoulder flexion and shoulder abduction. A standard goniometer was used initially in order to confirm that subjects achieved this end range of motion. The researcher provided verbal cueing to assure this approximate range of motion was achieved. The rate of each repetition was two seconds for the concentric phase and four seconds for the eccentric phase. Participants were guided with an audible metronome to maintain this pace.

For the Bodyblade Pro trials, participants performed shoulder abduction and flexion without oscillations (control) and with oscillations. As in the dumbbell trials, all exercises were performed standing with the feet shoulder width apart, the elbow at 0° of extension, and the forearm pronated. For shoulder abduction, subjects raised the Bodyblade to 90° and (1) held the position without oscillations for 15 seconds (control), and (2) generated oscillations for 15 seconds. The same procedure was repeated for shoulder flexion. The purpose of the control trials was to estimate the muscle effort required to move the Bodyblade Pro as a mass without performing oscillations.

The manufacturer recommends that an individual resist Bodyblade Pro oscillations for 60 seconds. However, pilot studies indicated that most novices begin to fatigue at approximately 15 seconds. Therefore, we determined that 15 seconds was sufficient time to acquire EMG data from the Bodyblade trials. A minimum rest period of one minute was given between trials to reduce muscular fatigue. Condition (dumbbell and Bodyblade) and position (shoulder flexion or shoulder abduction) were randomized to minimize a carry-over effect.

EMG data were acquired for the middle five seconds of each Bodyblade Pro trial and for the middle three repetitions of each dumbbell trial. We used video to determine when the subject's shoulder was between 85° and 95° of abduction or flexion. This camera allowed us to identify gross approximations for joint positions during the exercise. In this way, all data were collected while the shoulder was moving through a similar arc of motion while performing either the dumbbell or Bodyblade Pro exercise.

Data Processing

The raw EMG signals from the MVIC and exercise trials were rectified and smoothed using the root-mean-square 100 ms window. The average peak activity during the middle three seconds of the MVIC was used as the normalizing value. The average peak EMG activity for each muscle for each trial was normalized to its respective MVIC, creating a percentage of the MVIC for each muscle and for each condition.

The assumption of normality was tested using the Kolmogrov-Shmirnoff test, and skewness was evaluated using z-scores. Absolute z-scores > 2.0 were classified as skewed. Muscle data digressing from normality (i.e., infraspinatus values in the flexed position; and infraspinatus, pectoralis major, and erector spinae values in the abducted position) were transformed using the natural log. Transformed data were used for all statistical analyses.

Statistical Analysis

Separate one-way repeated measures ANOVAs were conducted for each muscle to compare muscle activity across the conditions (BPPro, control, Db5, Db8, and Db10). This analysis protocol was conducted separately for shoulder flexion and abduction. Hence, a total of 10 repeated measures ANOVAs were run, five for the flexed position and five for the abducted position. Prior to each ANOVA, Mauchly's test of sphericity was used to compare group variance across conditions. If sphericity was violated, Greenhouse-Geisser adjusted P values were used. In the event of a significant ANOVA, simple planned contrasts were used to compare the Bodyblade Pro condition (BBPro) to each of the other exercise conditions (control, Db5, Db8, and Db10). Significance was established at $p < 0.05$, and all analyses were performed using SPSS statistical software (Chicago, IL).

RESULTS

Results of the one-way repeated measures ANOVA across exercise conditions were statistically significant for all muscles during shoulder flexion (deltoid, $F = 18.08$, $p < 0.001$, $\acute{\eta}^2 = 0.64$; infraspinatus, $F = 20.25$, $p < 0.001$, $\acute{\eta}^2 = 0.67$; serratus anterior, $F = 30.614$, $p < 0.001$, $\acute{\eta}^2 = 0.75$; pectoralis major, $F = 12.23$, $p < 0.001$, $\acute{\eta}^2 = 0.55$; and erector spinae, $F = 4.60$, $p < 0.01$, $\acute{\eta}^2 = 0.32$). Simple planned contrasts revealed that the Bodyblade Pro (BBPro) elicited significantly greater muscle activity than the dumbbells (Db5, Db8, and Db10) or static Bodyblade Pro (control) for all muscles, except in comparison to the erector spinae during Db10 shoulder flexion (Table 1).

Results of a one-way repeated measures ANOVA across exercise device conditions were statistically significant for all muscles during shoulder abduction (deltoid, $F = 26.17$, $p < .001$, $\acute{\eta}^2 = 0.72$; infraspinatus, $F = 22.98$, $p < .001$, $\acute{\eta}^2 = 0.69$; serratus anterior, $F = 11.843$, $p < 0.001$, $\acute{\eta}^2 = 0.54$; pectoralis major, $F = 11.32$, $p < 0.01$, $\acute{\eta}^2 = 0.53$; and erector spinae, $F = 26.17$, $p < 0.001$, $\acute{\eta}^2 = 0.72$). Simple planned contrasts revealed that the Bodyblade Pro (BBPro) elicited significantly greater muscle activity than the dumbbells (Db5, Db8, and Db10) or static Bodyblade Pro (control) for all muscles (Table 2).

DISCUSSION

The purpose of this study was to compare the muscle activity of four shoulder muscles (deltoid, serratus anterior, pectoralis major, and infraspinatus) and one back muscle (erector spinae), when performing shoulder exercises with a Bodyblade Pro and three dumbbell conditions using weights of 2.3 kg (5 lb), 3.6 kg (8 lb) and 4.5 kg (10 lb). The results of our study provide evidence that performing shoulder abduction or flexion exercises with the Bodyblade Pro produces significantly greater muscle activity in the deltoid, serratus, pectoralis major, infraspinatus, and erector spinae than lightweight dumbbells. The only exception was in the erector spinae during shoulder flexion – the Bodyblade produced greater muscle activity in the erector spinae than all the dumbbell conditions, but was only statistically significant when compared to the three and five pound conditions.

Townsend et al.[7] concluded that dumbbell training produced significant shoulder muscle activity, defined as muscle activity exceeding 50% of a maximal voluntary isometric contraction (MVIC). Similar criterion were used by Tucker et al.,[15] who classified muscle activity as significant (>50% MVIC), moderately strong (35% to 50% MVIC), moderate (20 to 35% MVIC), or minimal (0% to 20%). Therefore, we elected to define significant activity as greater than 50% MVIC.

When looking at the average peak EMG, we found that the Bodyblade Pro produced substantial muscle activity in all five muscles in both shoulder flexion and abduction, as muscle activity exceeded 50% of MVIC for all conditions. The 10-pound dumbbell produced significant activity during abduction in the serratus, infraspinatus, and deltoid; and significant activity during flexion in the serratus and erector spinae. The eight-pound dumbbell produced significant activity during abduction in the serratus, infraspinatus, and deltoid; but only significant activity during flexion in the infraspinatus. Both the five-pound dumbbell and control trial failed to produce significant muscle activity in any muscle during flexion or abduction, when using this criteria of 50% of MVIC. Therefore, it appears that the Bodyblade Pro, despite being only 1.1 kg (2.5 lbs), has the greatest potential to elicit this requisite muscle activity, as it produced significant activity in all five muscles in both shoulder flexion and abduction. It should be noted that the EMG values of our study were based on peak values, and not on average sustained values. The ability of the dumbbells to elicit comparable muscle activity required at least 10 pounds, and even at this weight was still unable to reach the amount of muscle activity obtained with the Bodyblade Pro.

Our results indicated that the Bodyblade Pro produced the greatest EMG activity, relative to MVIC, in the serratus and infraspinatus. These muscles stabilize the scapula and facilitate humeral motion by providing a stable base for the prime movers of the humerus (i.e., the rotator cuff, deltoid, and long head of the biceps brachii), which can then offer dynamic stability to the glenohumeral joint.[16] Similar to our study, Lister et al.[10] examined EMG activity in the serratus anterior and trapezius muscles during abduction and flexion while using the Bodyblade, cuff weights, and theraband resistantce.. The authors found that the Bodyblade Pro elicited greater EMG activity in the scapular stabilizers compared to the Thera-band and cuff weights. Caution is advised when evaluating the infraspinatus results of our study. Data from several of our subjects far exceeded that of others, requiring us to log transform the data for analysis. Nevertheless, the extreme data resulted in %MVIC values that exceeded 100%. While it is not unusual for dynamic EMG to exceed values obtained from static activities, resulting in normalized values exceeding 100%, the infraspinatus was the only muscle in our study to demonstrate such extremes.

The trunk or core muscles also play a role in dynamic stabilization for upper extremity activities (i.e., stability during different positions, velocities, and loads). A strong core reduces the amount of force placed on the shoulder and elbow during throwing activities, and consequently reduces injury.[17] We evaluated a component of the core by measuring erector spinae activation and found that the Bodyblade Pro produced the greater muscle activity during shoulder flexion and abduction, when compared with the dumbbells. However, the higher erector spinae activity was not statistically significant when compared to shoulder flexion with a 10-lb dumbbell.

In regards to muscle activity, we found that the erector spinae reached 62.4% MVIC when using the Bodyblade during shoulder flexion. These results conflict with those of Moreside et al.,[11] who found that erector spinae activity reached only 27% MVIC during flexion with a Bodyblade Pro. The lack of agreement between our results and those of Moreside et al. could be explained by the following differences in methodology: (1) exercise position – we evaluated shoulder flexion during a vertical position, and Moreside et al. used a horizontal position; (2) exercise technique – we had subjects perform shoulder flexion using one arm, and Moreside et al. had subjects use both arms. The use of both arms in the Moreside study may have caused subjects to reach a greater degree of back extension to maintain their balance, and consequently reduced muscle activity; and (3) MVIC measurements – we manually resisted back extension as described by Kendall et al.,[14] while Moreside et al. manually resisted a combination of trunk movements (i.e., extension, side bending, and rotation).

Theoretical Implications

The Bodyblade Pro and dumbbell exercises are different activities, particularly in terms of the velocity of the movement. The literature indicates that changing the movement velocity alters the pattern of concentric and eccentric muscle activity: increasing velocity enhances concentric activity and decreases eccentric activity, while decreasing velocity has the opposite effect in that eccentric activity is enhanced.[18] Based on our results, we speculate that the Bodyblade Pro produces primarily concentric contractions due its high movement velocity. It is likely that the muscles of the shoulder do not eccentrically contract to slow the movement of the blade, but rather contract concentrically to change the blade's direction, at a very high velocity. Further, the high velocity requirement of the Bodyblade likely caused the corresponding EMG values to be elevated in comparison to the dumbbell movements.

Clinical Implications

The dumbbell exercises examined in this study are commonly used by athletic trainers and physical therapists in the early stages of shoulder rehabilitation.[7] The results of our study suggest that the Bodyblade activates multiple muscles within the shoulder and back during simple single plane shoulder motions (i.e., shoulder flexion and shoulder abduction). This might be beneficial in terms of exercise efficiency, although further research is required to evaluate this notion. Caution however is advised when using this device during early stages of shoulder rehabilitation; the high-speed movement may elicit muscle activity that exceeds the early ability of the shoulder.

Whether the Bodyblade produces an eccentric muscle contraction, which is essential for movement deceleration, remains inconclusive. The absence of the eccentric component may initially limit post exercise muscle soreness, and thereby benefit those in the early stages of rehabilitation. While this may seem beneficial, eccentric training is critical to long-term injury prevention.[2] Therefore, clinicians should be aware of this potential limitation of the Bodyblade to target eccentric action of shoulder and back muscles.

Limitations

There are several limitations of this study that must be acknowledged. Comparing activities that differ substantially in speed of movement (i.e., a BodyBlade that oscillates rapidly and dumbbells that are moved in controlled fashion) is risky. Therefore, selecting a Bodyblade rather than dumbbells due to its ability to elicit higher peak EMG may not be appropriate, as the higher movement velocity of the Bodyblade innately results in higher peak EMG.

The time window of data collection was not equivalent between the conditions. All activities were evaluated during the same short arc of motion, but more data point were acquired from the Bodyblade trials (5.0 seconds versus 2.0 seconds for the dumbbell trials). Consequently, the average peak value in the Bodyblade conditions was based on more data points. Using only peak EMG is also a concern, as it fails to account for the average activity of the muscles during a sustained repetition. However, we chose peak values in order to understand the maximal muscle effort required while using the Bodyblade, particularly because of its use in early shoulder rehabilitation.

The mass of the dumbbells was selected arbitrarily, based on clinical experiences. These lighter weights are common in the early stages of shoulder rehabilitation. It is not clear how the Bodyblade activity would compare with dumbbells of more substantial mass. In terms of range of motion of the exercise, this study only examined the effects of the Bodyblade in a limited arc of motion, similar to an isometric type exercise. The effects of this device on muscle activity during upper extremity movements with a full arc of motion cannot be inferred from these results.

Finally, the ability to generalize this study's results to individuals other than healthy young males is limited. The Bodyblade Pro is predominantly used for patients with a shoulder dysfunction, yet we used a healthy population to explore the effect of this device on shoulder muscle activity in comparison to dumbbells. We would expect that similar results would occur in older adults, females, and injured subjects. Nevertheless, we can only safely conclude that the Bodyblade produces significant EMG activity in the glenohumeral region of young healthy adults, and that such results would be clinically important for clinicians implementing the Bodyblade as a tool in a shoulder exercise program for young athletes.

Future Suggestions

As the current body of literature on the Bodyblade is limited, future studies are needed. The present study only examined the influence of the Bodyblade on muscle activity, in a limited arc of motion. The validity of other claims by the manufacturer (e.g., strength improvement, pain relief, aerobic benefits, and improved proprioception) remain unknown. As such, studies to determine if the Bodyblade can improve strength, aerobic capacity, and proprioception are warranted. Additionally, since the Bodyblade Pro is primarily used for rehabilitation, evaluating its effects in an injured population is warranted.

CONCLUSION

The Bodyblade Pro appears to be an effective device for activating the shoulder and back musculature for rehabilitative purposes. The inherent movement pattern of the Bodyblade – specifically its high velocity – produced greater muscle activity in all five muscles compared to standard lightweight dumbbells. Further research is needed to evaluate the exact nature of muscle contraction created when using the Bodyblade, and to determine its effects in an unhealthy population. Nevertheless, we believe that the Bodyblade Pro is a rehabilitation tool worthy of future research.

REFERENCES

1. Prentice WE. *Rehabilitation Techniques for Sports Medicine and Athletic Training*. New York, NY: McGraw Hill;2004.
2. Lachowetz T, Drury D, Elliot R, Evon J, Pastiglione J. The effect of an intercollegiate baseball strength program on the reduction of shoulder and elbow pain. *J Strength Cond Res.* 1998;12(1):46-51.
3. Treiber FA, Lott J, Duncan J, Slavens G, Davis H. Effects of theraband and lightweight dumbbell training on shoulder rotation torque and serve performance. *Am J Sports Med.* 1998;26(4):510-515.
4. Baechle TR, Earle RW. *Essentials of Strength Training and Conditioning*. Champaign, IL: Human Kinetics;2000.
5. Giannakopoulos K, Beneka A, Malliou P, Godolias G. Isolated vs. complex exercise in strengthening the rotator cuff muscle group. *J Strength Cond Res.* 2004;18(1):144-148.
6. Malliou PC, Giannakopoulos K, Beneka AG, Gioftsidou A, Godolias G. Effective ways of restoring muscular imbalances of the rotator cuff muscle group: a comparative study of various training methods. *Br J Sports Med.* 2004;38(6):766-772.
7. Townsend H, Jobe FW, Pink M, Perry J. Electromyographic analysis of the glenohumeral muscles during a baseball rehabilitation program. *Am J Sports Med.* 1991;19(3):264-272.
8. Hymanson B. Why Bodyblade Pro? BodyBlade Pro Website. http://www.BodybladePro.com/. Accessed September 17, 2006.

9. Rose T, Perez L, Miller AL. Strength and functional outcomes of training with the Bodyblade Pro with high school baseball players. *Med Sci Sports Exerc*. 1996;28(5):190.

10. Lister JL, Rossi GD, Ma F, Stoutenberg M, Adams JB, Tobkin S, Signorile JF. Scapular stabilizer activity during Bodyblade, cuff weights and thera-band use. *J Sport Rehabil.* 2007;16:50-67.

11. Moreside JM, Vera-Garcia FJ, McGill SM. Trunk muscle activation patterns, lumbar compressive forces, and spine stability when using the Bodyblade Pro. *Phys Ther.* 2007;87(2):153-163.

12. Schulte RA, Warner C. Oscillatory devices accelerate proprioception training. *Biomechanics.* May 2001;85-91.

13. Cram J, Kasman G, Holtz J. *Introduction to surface electromyography*. Gaithersburg, Maryland: Aspen Publishers; 1998.

14. Kendall FP, McCreary EK, Provance PG. *Muscles, Testing and Function: with Posture and Pain.* 4th ed. Baltimore, MD: Williams & Wilkens;1993.

15. Tucker WS, Armstrong CW, Swartz EE, Campbell BM, Rankin JM. An electromyographic analysis of the cuff link rehabilitation device. *J Sport Rehabil.* 2005;14:124-136.

16. Blackburn TA, Guido JA. Rehabilitation after ligamentous and labral surgery of the shoulder: guiding concepts. *J Athl Train.* 2000;35(3):363-381.

17. Aguinaldo AL, Buttermore J, Chambers H. Effects of upper trunk rotation on shoulder joint torque among baseball pitchers of various levels. *J Appl Biomech.* 2007;23:42-51.

18. Potvin JR. Effects of muscle kinematics on surface EMG amplitude and frequency during fatiguing dynamic contractions. *J Appl Physiol.* 2007;82:144-151.

Table 1. Peak EMG Activity of Shoulder and Back Muscles (%MVIC) during Shoulder Flexion for Different Device Conditions

	Average Peak Muscle EMG (%MVIC)*				
Device	**Deltoid**	**Infraspinatus**§	**Serratus Anterior**	**Pectoralis Major**	**Erector Spinae**
BBPro	61.32 ± 18.18	189.10 ± 233.02	71.89 ± 16.94	71.41 ± 21.73	62.40 ± 23.40
Control	19.79 ± 5.60†	18.53 ± 5.53†	25.29 ± 9.31†	45.24 ± 38.54†	41.10 ± 10.30†
Db5	33.08 ± 11.27†	44.24 ± 29.54†	34.95 ± 11.00†	43.57 ± 33.89†	45.10 ± 16.34†
Db8	36.94 ± 13.08†	50.55 ± 29.40†	42.69 ± 9.50†	41.62 ± 32.65†	43.33 ± 12.90†
Db10	40.57 ± 15.91†	49.13 ± 26.72†	50.50 ± 13.74†	44.79 ± 32.23†	53.81 ± 29.30

Abbreviations: MVIC, maximum voluntary isometric contraction; BBPro, BodyBlade Pro; Control, static Bodyblade Pro; Db5, 5 lb dumbbell; Db8, 8 lb dumbbell; Db10, 10 lb dumbbell.

*Values are average Peak ± SD.

†Significantly lower than BBPro condition ($p < 0.05$).

§Values log transformed for statistical analysis.

Table 2. Peak EMG Activity of Shoulder and Back Muscles (%MVIC) during Shoulder Abduction for Different Device Conditions

	Average Peak Muscle EMG (%MVIC)*				
Device	**Deltoid**	**Infraspinatus**§	**Serratus Anterior**	**Pectoralis Major**§	**Erector Spinae**§
BBPro	89.09 ± 27.82	236.80 ± 271.94	83.08 ± 22.56	65.84 ± 32.92	57.32 ± 37.34
Control	31.25 ± 9.31†	41.45 ± 32.66†	33.81 ± 20.81†	37.53 ± 37.18†	39.03 ± 44.19†
Db5	44.89 ± 10.61†	48.25 ± 25.89†	41.47 ± 12.00†	38.50 ± 37.34†	40.03 ± 42.25†
Db8	57.04 ± 15.27†	59.86 ± 30.24†	53.35 ± 18.54†	38.43 ± 36.25†	35.47 ± 39.03†
Db10	65.63 ± 20.16†	70.03 ± 34.22†	57.99 ± 17.32†	40.26 ± 36.88†	43.63 ± 43.60†

Abbreviations: MVIC, maximum voluntary isometric contraction; BBPro, BodyBlade Pro; Control, static Bodyblade Pro; Db5, 5 lb dumbbell; Db8, 8 lb dumbbell; Db10, 10 lb dumbbell.

*Values are average Peak ± SD.

†Significantly lower than BBPro condition ($p < 0.05$).

§Values log transformed for statistical analysis.